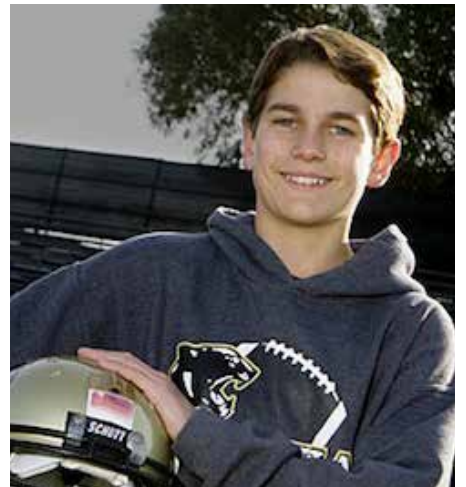




# 7 AMAZING TEEN INVENTORS





To make his radically faster and cheaper test a reality, Jack had to ignore 200 scientists telling him, “No.”



## HOW A TEENAGER INVENTED A BETTER TEST FOR PANCREATIC CANCER

In 2011, Jack Andraka’s uncle died of pancreatic cancer, a particularly deadly disease. In 2012, the 15-year-old invented a paper test strip that gives doctors a way to detect pancreatic cancer much earlier, giving patients like his uncle a better chance of surviving.

This type of cancer is usually fatal because the pancreas is deep inside the abdomen, so tumors may not show up until they’ve grown big. However, high levels of a protein called mesothelin in a person’s blood can be a clue that the tumors exist. But until the Maryland teen’s invention, there was no quick, inexpensive way to test for mesothelin.

Jack’s test strips accurately detect unusual levels of mesothelin in the blood long before the cancer becomes life-threatening. He used filter

paper coated with microscopic tubes of carbon just a single atom thick. Antibodies on the tubes attract mesothelin, spreading the tubes apart. As more protein piles up, the carbon’s resistance to the flow of electricity drops. This decrease can be measured, revealing the presence of the mesothelin.

Jack’s method is much faster and more sensitive — and way cheaper — than the standard diagnostic technique known as ELISA, or enzyme-linked immunosorbent assay. His discovery won the 2012 Intel International Science and Engineering Fair, the world’s largest international science fair for pre-college-age kids.

But it wasn’t easy for Jack, who’s loved science since he was a toddler, to convince adult researchers that his idea was worth a shot. He was rejected by 200 scientists in his quest to find someone to let him work on his project in an existing lab! Finally, a scientist at Johns Hopkins University listened, and gave him space to make his idea real. Jack predicts his test will replace the ELISA in just a few years. Who knows what else he’ll have invented by then?



Texting while driving? You're up to 23 times more likely to crash. The Inventioners created the SMARTwheel to help stop senseless accidents.



## TEEN INVENTORS CREATE ANTI-TEXTING STEERING WHEEL TO SAVE LIVES

Everyone knows texting while driving is a bad idea. It's dangerous, dumb, and illegal. But that doesn't stop people from doing it. In fact, texting while driving has become the leading cause of death for teenagers ... and adults. In 2011, almost a quarter (23 percent) of all car crashes involved cellphones – 1.3 million accidents.

Here's why: Texting takes a driver's eyes off the road for at least five seconds, and usually longer. But if you're driving at 55 mph, you'll cover the length of a football field in five seconds ... without looking at the road. All kinds of things can happen: Other cars stop or change lanes, people step into the road, accidents happen up ahead ... and if a driver isn't aware of what's coming, he or she can get into real trouble. Texting makes crashing up to 23 times more likely.

So a group of teens who call themselves the Inventioners decided to do

something about this growing and dangerous problem. They created the SMARTwheel™, a device that fits on a steering wheel and monitors a driver's hand positions. The name is an acronym for Safe Motorist Alert for Restricting Texting, Tweeting, Typing, Touchscreens, Takeout and Touch-up. (No eating or fixing your makeup while driving, either!)

How it works: The SMARTwheel senses if you take one or both hands off the wheel for more than a very brief time, and it provides instant audio and visual feedback.

It also logs unsafe driving and can be set to transmit a record of someone's driving to other people, such as parents, employers, teachers, and even – for people with very bad driving records – parole officers. The device has been tested at MIT and even at the White House, where it got a thumbs-up from President Obama.

This isn't the first time the New Hampshire teens have invented something useful. They've also created a self-powered water filtration system and a unique biofuel generator.



2 billion people don't have access to modern conveniences. So 17-year-old Catherine Wong invented an electrocardiogram test that anyone can perform using a simple cellphone.



## TEEN INVENTS BLUETOOTH EKG TO HELP KEEP HEARTS HEALTHY

In the developed world, when you need a heart exam, it's available at most any doctor's office or hospital. In poorer parts of the world, it's not so easy to get a heart check-up. In fact, 2 billion people don't have ready access to modern conveniences. In 2012, that inspired 17-year-old Catherine Wong to invent an electrocardiogram test that anyone can perform using a simple cellphone.

With her invention, people could send real-time data about their hearts to doctors, using not much more than a Bluetooth-enabled cellphone. The New Jersey teen's invention could help doctors remotely diagnose and keep tabs on people all over the world.

The test doesn't require a fancy smartphone or an Internet connection — Catherine designed it to use a basic phone and readily available electrical parts that don't cost much. (She doesn't even own a smartphone! But she

does have a flawless SAT score.)

### What is an electrocardiogram?

It's a common test that measures the heart's rhythms and electrical activity to see how well it's functioning. It works kind of like a magnifying glass to measure the heart's rate, its position in the chest, and any abnormal patterns that may indicate problems.

### How does Catherine's device work?

Electrodes — attached to specific spots on a user's torso — measure the heart's electrical activity. The microprocessor board that's part of this invention converts the data and sends the readings through Bluetooth onto a simple Java-enabled cell phone ... which then sends it to a doctor.

### What is Bluetooth?

It's a technology standard that lets phones transmit data wirelessly to other devices that are within 30 feet. We usually see Bluetooth used for phone earpieces, speakers, and to connect cellphones with in-car audio systems. It's named for a long-ago king of Denmark and Norway named Harald "Bluetooth" Gormsson, who had a very obvious bad tooth but was great at getting different groups to work together.



After creating Cloud4Cancer to detect breast cancer, Brittany Wenger adapted it to help diagnose leukemia. “Helping to find a cure for cancer is a real goal of mine,” she says.

## TEEN BUILDS CLOUD- BASED NEURAL NETWORK TO DIAGNOSE DISEASES



Breast cancer affects one in eight women. Now, thanks to Brittany Wenger of Sarasota, FL, doctors around the world can use her Cloud4Cancer Breast Cancer Detection tool to identify and treat this disease more easily.

In seventh grade, Brittany read about artificial intelligence and became “obsessed” with the concept. So obsessed that she took a class and learned to write computer code. Her first AI project was a program that learned to play soccer.

But when she was in 10th grade, her cousin was diagnosed with breast cancer, and Brittany decided to see if she could help. She spent “hundreds upon hundreds of hours researching,” she later said, and created a program that trained the computer to determine whether a mass in the breast was malignant (bad) or benign (good), based on a description of its cells.

The tool lets a doctor input the data using pulldown menus on a simple web interface. More important, getting those cells requires only a fine-needle aspiration, which is the least invasive way to

remove tissue for a biopsy. Until Cloud4Cancer, doctors couldn’t really rely on that test for a diagnosis.

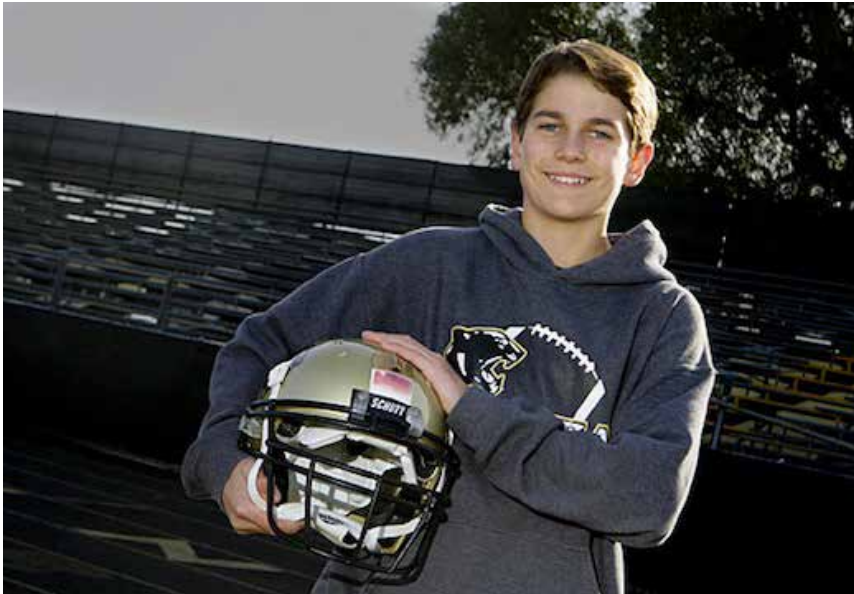
But now they can, because Cloud4Cancer diagnoses more than 99 percent of patients correctly. And it’s cloud-based, so any hospital with Internet access can use it. So far, it has performed almost 8 million tests. Brittany won the Google Science Fair Grand Prize in 2012 for it.

“Helping to find a cure for cancer is a real goal of mine,” she says. After winning the prize, she said she “wanted to prove that the infrastructure I built could work with multiple diseases.” So last year, at age 18, she used her neural network to help doctors diagnose an aggressive form of leukemia. As she told the tech site Mashable, computers “can actually learn to detect things that transcend human knowledge.”

Brittany is studying at Duke University now, and she wants to be a pediatric oncologist. She has given several TEDx talks and even explained her invention to President Obama at the White House. TIME Magazine recently put her on its list of Thirty Under Thirty people who are changing the world.



Lots of people talk about how dangerous concussions on the football field can be. This young player did something about it.



## TEEN FOOTBALL PLAYER BRAEDEN BENEDICT INVENTS HELMET-MOUNTED CONCUSSION SENSOR

When Braeden Benedict was an eighth-grade football player, he watched a teammate get hit pretty hard on the field. The friend was shaken up, but he got up and back into the game. Later in the week, he developed headaches — and that’s when he was diagnosed as having suffered a concussion.

He should not have kept playing after getting hit. Subsequent impacts after even minor head trauma can cause serious brain injuries that lead to dementia, memory loss, personality disorders, and other issues later in life. So letting the brain recover after a shock is extremely important. Don’t “just play through it.”

Braeden started thinking about how to create a simple, low-cost sensor that alerts people when game impacts might cause concussions. High-tech electronic sensors for helmets do exist, but they’re too costly for most

schools and after-school leagues.

And that’s a real issue. In 2009, almost a quarter million kids 19 and under showed up at emergency rooms with concussion-related injuries, according to the Centers for Disease Control and Prevention. And that’s just the kids who showed up.

So in 2012, at age 15, Braeden adapted a shipping industry tool that measures how hard boxes are dropped, in case the contents get damaged. Braeden’s device is a thin, liquid-filled patch that attaches to the front of a helmet. When a player gets hit hard enough, the sensor measures the severity of the impact. It’s great for football, and also for hockey and lacrosse players.

Both his parents are engineers, so Braeden grew up making things. Once he’d figured out this device, he made a short video to explain the concept and entered it in the Discovery Education 3M Young Scientist Challenge. He won a \$25,000 grant to develop it, and then a 3M engineer got in touch. They developed a prototype, and now it’s been patented!



In a country that gets electricity maybe once a week, Kelvin Doe created batteries, a generator, and a radio station ... out of garbage.

## HOW A TEEN INVENTOR IN AFRICA USED TRASH TO REACH MIT



In Sierra Leone, a small West African country, the electricity comes on maybe once a week. The rest of the time, says teen inventor Kelvin Doe, people live in darkness in his hometown, a district of Freetown, the capital.

Commercial batteries are costly, so at age 13, he started making his own using basic supplies: acid, soda, metal, a tin cup, and tape. As early as age 10, Kelvin was building cool things out of stuff he salvaged from the garbage.

He made a radio station for his town and a generator (using a discarded voltage stabilizer) to power it. He found staffers for the station — their average age was 12 — and played music and reported the news, using the broadcast handle DJ Focus.

“They call me DJ Focus,” he said, “because I believe if you focus, you can do an invention perfectly.” Kelvin said he wanted to give a voice to the youth of Sierra Leone and enable his countrymen to debate issues. What’s more, his neighbors can charge their phones using his generator.

In March 2012, David Sengeh, a PhD candidate at MIT who’s also from

Sierra Leone, went home to start a national high school innovation challenge. Innovate Salone, as he called it, asked teens to propose solutions to problems around them. About 300 smart kids participated, but Kelvin stood out.

He stood out so much, Sengeh arranged for him to visit the World Maker Faire in New York and also MIT and Harvard, where Kelvin lectured to college students and became the youngest person ever invited to MIT’s “Visiting Practitioner’s Program.”

Kelvin later won his nation’s Presidential Medal and met the Clinton family in New York, when he spoke at the Clinton Global Initiative’s closing ceremony. He even joked with Chelsea about wearing a suit.

In 2013, he signed a \$100,000 contract with a Canadian wi-fi company to develop a solar-panel technology for installation at 400 sites around Sierra Leone. He’s also been working on a windmill, which may be done by the time you read this. And Kelvin will probably be doing some new cool thing by then too.

“Through innovation,” he says, “We can build our nation Sierra Leone.”



The Victoria, BC, teen was inspired by the fact that the human body generates so much heat. Ann says, “We’re like 100-watt walking light bulbs.”



## TEEN INVENTOR'S BATTERY-FREE FLASHLIGHT RUNS ON HAND'S HEAT

In 2013, at age 15, Canada’s Ann Makosinski invented an LED flashlight that needs no batteries — it runs on heat from the hand that’s holding it!

“The Hollow Flashlight,” as Makosinski calls it, taps the body’s thermal energy using Peltier tiles, which produce electricity when you heat one side and cool the other. She made it using aluminum tubing, PVC pipe, foam insulation, and the Peltier tiles.

To power the tiles, the hand holding the flashlight must be at least five degrees Celsius warmer than the ambient air, which flows into the hollow tube and cools the underside of the tiles. The power produced by the average hand yields 5.4 mW at five foot candles of brightness (that’s the light of five candles as seen from a distance of one foot).

She entered her invention in the 2013 Google Science Fair. As one of 15 finalists, Ann became the only Canadian to fly to the tech giant’s

Mountain View, CA, headquarters to present work for that fair.

The Victoria, BC, teen was inspired by the fact that the human body generates so much heat. Ann says, “We’re like 100-watt walking light bulbs.” She did tons of web research, and you can read a detailed record of her work in her presentation on the Google Science Fair site.

Even more amazing: She submitted her project just under the wire — a mere 45 minutes before the Google deadline. Makosinski blamed homework and time she had already committed to a project for a local science fair. She’s kind of a science fair vet: In 2012, when she was just a ninth-grader, Makosinski won awards at a Canadian science fair with her Piezoelectric Flashlight, a slightly dimmer but equally green invention.

Her work could spark new ideas for clean energy. As she put it in her Google presentation, this technology could be used to heat schoolrooms, recharge cell phones, and even power wireless medical sensors.

Can we say ... her future looks bright